Coal and Air Flow Measurement for Reduced NOx and UBC

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Any deviation from the design air/fuel balance at individual burners result in some burners operating at a fuel lean or a fuel rich condition. The fuel rich burner is producing large amounts of CO, high LOI and longer flames while locally lowering the oxygen level in the flue gas. On the other hand, the fuel lean burner produces high NOx levels at elevated O_2. The outcome at the boiler exit is a flue gas with high CO and high NOx. In addition, LOI is elevated due to the burners operating at low stoichiometries.

Electric Charge Transfer Technology

The patented ECT technology measures the electric charges present in any two phase flow transport and uses the signals to determine the relative coal distribution between the conduits of one mill. In addition, the system can be configured to measure the flow velocity and the absolute flow in each conduit. Foster Wheeler is partnering with TR-Tech International Oy of Finland to market the Electric Charge Transfer technology (ECT) worldwide. Foster Wheeler is the global distributor of the ECT system.

The high data collection rate of the ECT system allows to monitor also unsteady phenomena in coal conduits that can cause problems during plant operation. The signals can be used to detect coal conduit layout due to insufficient primary air flow from the mill and coal conduit surging which results in furnace pressure and emissions fluctuations.

Finally, the ECT system can be applied to monitor the particle size changes of the coal flow. The antennas and the hardware used for this system are the same as in the coal flow distribution application.

The ECT system can be configured to serve in all of the above areas of use. The features are described in more detail in the presentation.

The ECT system for the coal flow balance consists of three receiving antennas in each coal conduit that are connected to a signal conditioning unit. This signal conditioning unit is in turn connected to a personal computer that is used for data processing and analysis. TR-Tech's proprietary software is used to determine the balance between the conduits of one mill, to display the results to the operator and to feed

the data via a network to the plant's DCS system or a continuos combustion optimization software running on a separate computer.

The antennas are easily installed through the wall of the existing conduit and they are inserted approximately one inch into the coal stream. Three antennas in one conduit are connected together. Their location in the pipe wall is determined so that the effects of coal ropes on the measurement results are minimized. Antennas are made of hardened steel to ensure long operating life. The installation is very simple and requires only a mill taken out of service for several hours which minimizes lost generating capacity. After installation, the ECT measurement is verified by a standard ASME or other conventional sampling procedures and the system is then ready to be used.

The ECT system offers several distinct advantages:

- The ECT system is not affected by coal characteristics, moisture or ash content or coal roping.
- It works effectively in both vertical and horizontal conduit arrangements.
- The system has very simple installation requirements compared to other technologies.
- There are no power requirements for its sensors, and cabling can be run up to 1000ft/350m.
- It offers full time continuous indication of coal flow or particle size.
- It has been applied successfully for cement, limestone, coal and pumice applications.
- Other applications include troubleshooting of coal layout and coal roping in horizontal coal pipe runs or burner coal nozzles.
- The same measurement principle can be applied to obtain different information. The ECT system can be configured to
  - determine the coal flow in conduits
  - measure the particle velocity in the pipes
  - monitor unsteady phenomena in coal conduits (layout, surging, etc)
  - monitor particle size changes of the coal

In general, the results of the ECT method compare very well with a standard ASME probe test even at extreme shifts of the coal flow between the conduits. This confirms the viability of the technology for real time coal balancing applications.

Particle size detection is another application for the ECT system. Changes in fuel fineness have an impact on the unburned carbon in the fly ash and can offset improvements that careful burner air and fuel balancing might yield. Manual coal flow sampling and subsequent sieving is usually performed to detect any performance degradation of the pulverizing system which is a time consuming process.

The pulverizer fineness performance is impacted by many variables such as hardgrove index, moisture, mill wear, grinding force or classifier setting. Almost all of these constantly change, which makes it difficult to maintain a constant fuel fineness and to monitor the mill maintenance condition.